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ENVIRONMENTAL NOISE MONITORING AT THREE SITES IN IRVING TEXAS, NOVEMBER-DECEMBER, 1974

George J. Putnicki, et al

Environmental Protection Agency
Dallas, Texas

February 1975

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ENVIRONMENTAL NOISE MONITORING AT THREE SITES IN IRVING, TEXAS

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REGION VI DALLAS, TEXAS

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16. ABSTRACT

The major objective of this study was to sample and evaluate noise exposures in a community adjacent to Dallas/Fort Worth Airport where aircraft noise complaints have multiplied. The day-night average sound level at three sites was measured for each of seven days using prototype, automatic computerized sound sampling systems and a special iterative tape recording system. Results were spot-checked with convential equipment. The noise exposure was within the error tolerances of the NEF-CNR contour map predicted for D/FW airport although it exceeded the EPA guideline of 55 dBA Ldn. Aircraft from D/FW were identified as a major noise source.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Aircraft Noise Jet Aircraft Noise Airport Noise Transportation Noise Community Noise	Day-Night Average Sound Level Dallas Airport Acoustic Measurement Sound Recording	

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ENVIRONMENTAL NOISE MONITORING
AT THREE SITES IN IRVING, TEXAS
NOVEMBER-DECEMBER, 1974

A Joint Project of the

U.S. Environmental Protection Agency and the

Federal Aviation Administration

U.S. Environmental Protection Agency

Region VI

Dallas, Texas

DISCLAIMER

This report has been reviewed by Region VI, EPA, and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

FAA participation in the project was limited to onsite monitoring and recording of sound pressure levels (dBA) on dates specified at sites shown and a comparison of these recorded measurement with the forecast zones of perceived sound resulting from aircraft operations at D/FW as published in the NCTCOG Sound Map of 1971.

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I. CONCLUSIONS

1. The noise exposures predicted at the three sites by the FAA and published in a composite NEF-CNR contour map in 1971 for land use planning did not exceed measured noise exposures within the error tolerances of the comparisons of the predictions and the measurements for this sampling period.

2. Based on the sampling, aircraft are a major source of noise at all three sites and commercial jet traffic from D/FW Airport is one of the major contributors to the overall noise energy caused by aircraft.

3. The very loudest sources recorded at the Trinity and Cox Drive sites were pairs of low flying military jet aircraft. Fortunately, these flyovers, during which the levels reached 90 dBA, were infrequent and short in duration.

4. When the prevailing wind is from the south and Runways 17L and 17R are used, the noise exposure is increased a noticeable amount (2-5 dBA) at all three sites, especially during peak D/FW traffic hours as compared to those same hours during a prevailing north wind when Runways 35L and 35R are used.

5. Wind conditions and runway usage during the monitoring period were such that almost three days of "worse condition" monitoring were possible, i.e., when 17L and 17R were used primarily. FAA monitoring took place during these two periods.

6. The flight procedure changes by D/FW Airport Board caused a noticeable reduction in the maximum noise levels received at the Sherwood Village site, the only site measured both "before" and "after" D/FW flight procedure changes.

7. The EPA-identified outdoor level of L_{dn} = 55 dBA, which has an adequate margin of protection to safeguard the public health and welfare from communication and sleep interference, was exceeded at all three sites for all monitoring days and L_{dn} = 60 was exceeded at Sherwood Village repeatedly. By EPA criteria, as stated in the Levels Document,(1) these levels can be annoying to a significant percentage of the people that must endure it over long periods of time. (This document only establishes criteria as a decision-making tool and is not an accepted goal, standard, or regulation.)

8. The unmanned microsampling tape recorder method of measurement and identification of jet aircraft sources was successful and compared well with data obtained by trained observers. During the unmanned periods, the origins of the jet aircraft were not determined.

(1) The numbers in parentheses, which will appear throughout the Report, are keyed to reference materials that are listed in Part XI, Page 49.

II. RECOMMENDATIONS

From the noise exposure data collected at three sites in the City of Irving, it is recommended that:

1. Any changes in flight procedures at D/FW Airport and any other airport in the Dallas/Fort Worth Metropolitan Area take into consideration the impact of the aircraft noise on people.

2. The City of Irving interpret and use NEF contours as very broad areas, not lines, and keep the error tolerances of such contours in mind when employing them in future land use planning.

III. INTRODUCTION

The Environmental Protection Agency's noise control activities are authorized by the "Noise Pollution and Abatement Act of 1970" (Title IV of the Clean Air Act), and the "Noise Control Act of 1972" (Public Law 92-574). The Federal Aviation Administration is also assigned certain responsibilities in the control and abatement of aircraft noise in Section 7 of the latter Act.

The broad mission of the EPA Office of Noise Abatement and Control is to identify and classify causes and sources of noise, to determine their effects on public health and welfare, and to propose any needed National standards and regulations necessary to protect the public health and welfare. Noise monitoring activities are authorized in the Noise Control Act under Section 14, which deals with research, technical assistance to State and local governments, and public information.

The Region VI EPA noise control program has included noise monitoring upon request to the cities of Waco, Texas, Dallas, Texas, Grand Prairie, Texas and Tulsa, Oklahoma. The program has also worked with the State of Texas on several occasions. In addition, Region VI has performed several special tasks for the Washington EPA Office of Noise Abatement and Control in another program, along with three other EPA Regions, in developing a national noise monitoring methodology and in applying the

methodology to special types of major sources, e.g., railroad noise monitoring in railroad yards and along right-of-ways (September 1974).

Given the above authorization and experience in noise monitoring, EPA Regional Administrator Arthur W. Busch responded affirmatively to a request in a letter dated November 13, 1974 by the City of Irving, Texas, for noise monitoring (Appendix A). Because of limited resources, only one of the suggested sites was monitored during the period November 21-25, 1974 by EPA only.

Congressman Dale Milford held a public hearing on November 22, 1974 at the Irving City Hall to air community views on the impact of aircraft flight operations at D/FW Regional Airport. Representatives of ALPA (the airline pilots association), the D/FW Airport Board, FAA, EPA, and leaders of Irving and other nearby communities participated in the discussion.

An outcome of the hearing was the formation of a special task force comprised of Federal government officials, City of Irving officials, the D/FW Airport Board, ALPA, ATA (Air Transport Association), and citizen leaders of CAN (Control Airport Noise). At its initial meeting on November 25, the task force endorsed the recommendation of Congressman Milford that the Regional offices of EPA and FAA conduct a joint noise monitoring program.

Acting on this recommendation, officials of FAA and EPA met on December 10 and drew up a plan to accomplish the suggested action. Three sites were selected at which noise monitoring was to be conducted during the period December 12-18, 1974. (See documents B and C in the Appendix.)

IV. SITE SELECTION

The three sites chosen for noise monitoring were, (1) Sherwood Village Mobile Home Park near the intersection of Shady Grove and Beltline Roads in southwestern Irving; (2) Private residence at 2625 Trinity Street in northwestern Irving; and (3) Private residence at 624 Cox Drive in northern Irving (see map in Figure 1). All three sites were in residential areas. They were chosen because they were in widely separated areas of the city from which a large number of complaints about aircraft noise were being received. Availability of electrical power and protection of the equipment were added considerations.

The microphone locations at each site were chosen so that no nearby noise source was dominant. The steady background noise levels at the sites and locations caused by local neighborhood sources were typical for suburban residential areas.

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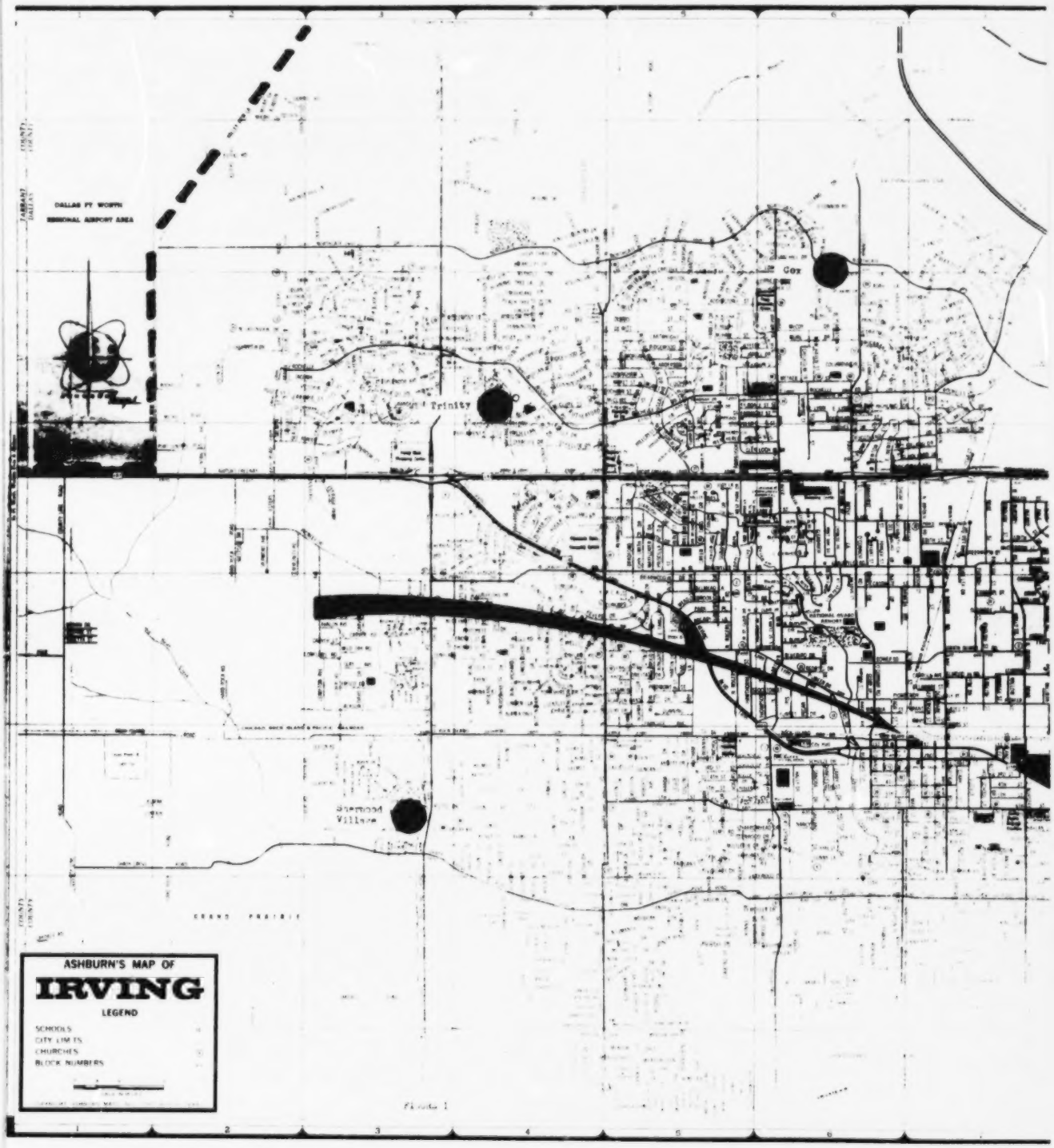


V. PROJECT OBJECTIVES

The major objective of this noise monitoring activity was to measure the noise levels and evaluate the noise exposures at several specific sites of Irving, Texas, as requested by the City.

VI. EQUIPMENT AND METHODOLOGY

The noise level amplitude measurements were performed by a special automatic computer sampling system specifically constructed by the Construction Engineering Research Laboratory Acoustics Branch of U.S. Army Corps of Engineers at Champaign, Illinois. The system consists of mostly off-the-shelf equipment and built according to specifications written by the EPA group (including Region VI) responsible for developing a national noise monitoring methodology.

The unit makes measurements according to the standards of the American National Standards Institute for a Type I precision sound level meter. Once the measurements are made, the results are stored automatically by a desktop programmable computer. This capability enables the unit to take 10 samples per second (36,000 per hour) for 24 hours without stopping. It has a very wide dynamic range and is capable of taking decibel measurements on "A" weighting (dBA) between the limits of 40-120 dBA with a time constant of 0.2 sec. ("fast" scale). The microphone used is a B&K 4921 outdoor microphone with a built-in electrostatic calibrator and constructed for all-weather operation. An anemometer operates with the system and all data taken during windy conditions is separated and "saved" in a special place by the computer. The amplitude measurement samples are stored in eighty 1dB wide amplitude bins, and the number of samples

in each bin is recorded or digital tape at the end of each hour. At the end of the 24-hour sampling period, all samples (864,000) can be recalled. Computer programs are then used to reduce the data and to perform statistical analyses with the data, including calculation of the daily equivalent noise energy exposure descriptors L_{eq}/L_{dn} used by EPA (see Glossary).

At the Sherwood Village site, a special tape recording system was employed to assist in identifying sources of noise the computer was sampling. A two-track, magnetic reel-to-reel, tape recorder (Sony TC 850), using Ampex 404 Low Noise Tape, was used in a microsampling mode. That is, the tape recorder was turned on periodically at 20-second intervals for 1.5 seconds. This intermittent recording of a portion of the sound field permitted recording on a single 1800 foot, seven-inch reel of tape to record 20 hours of background sources. This tape was calibrated and on it were recorded sounds picked up by the outdoor microphone. Thus, when the tape was played back through a Graphic Level Recorder and listened to at the same time, the sources and their levels could be measured and also identified audibly. Since the recordings were made at 20-second intervals, few of the noise sources were missed. This system had been checked in the laboratory and found to be quite reliable and accurate. In addition to permitting identification of the major noise sources, this system also allows the estimation of the contri-

bution made by any one source to the total noise energy of a given period.

At all three sites, continuous, reel-to-reel, analog tape recordings were made frequently during peak airport activity periods and other non-peak periods. Equipment used was a Nagra SJ two channel recorder.

Measurements were also made by the FAA of the maximum noise levels of each aircraft during peak periods when the operations were to the south at each site using an ANSI-type II "handheld" sound level meter set on "dB(A) slow" which was mounted on a tripod. Each site was also equipped with a two-way radio, acoustical calibrator, and a simple weather station.

In an effort to observe aircraft sound levels for various types and weights of aircraft operating from D/FW, the FAA manned the sites at Sherwood Village from December 12 - 1310 hour to December 13 - 0155 hour; Cox Site on December 17 from 1332 hour to 1440 hour then from 1810 hour to 1956 hour; Trinity site on December 17 from 1236 hour to 1344, then from 1810 hour to 1955 hour. Cox and Trinity sites were manned during peak periods of D/FW operations. The manning of sites at those times would permit verification of aircraft operating from D/FW but not Dallas Naval Air Station or Love Field, although military and other aircraft do operate in the vicinity of the sites. Verification

was done by means of radio contact with the D/FW Tower and the TRACON using the ARTS-III radar equipment. ARTS-III was used to further identify aircraft type, gross weight, pilot operating procedures, position over site, flights tracks and altitudes flown.

The accuracy of the automatic system is ±0.5 dBA while that of the microsampling and continuous tape recording is ±1.5 dBA. The Type II sound level meter has an accuracy of ±2 dBA due to a less accurate ceramic microphone. Discrepancies of measurements of peak levels with the Type II sound level meter and the automatic system are due to differences in the accuracies of the two instruments and to the use of the "slow" scale on the Type II meter as opposed to the "fast" scale of the Type I system. The "slow" scale has a much longer response time (0.5 sec.) and tends to read rapidly varying, transient peak levels from 2-5 dB lower than it would on the "fast" (0.2 sec.) response scale. Both scales give the same readings for slowly varying noise levels.

VII. RESULTS

The data results for Sherwood Village are divided into two monitoring periods, November 21-25, 1974 (before) and December 12-18 (after). The "before" and "after" signify when the monitoring was done with respect to a modification in flight patterns at D/FW Airport announced by D/FW Airport Board on December 5, 1974 (Appendix D). The other two sites, Cox Drive and Trinity Street, were monitored "after".

An example of the raw computer data output can be seen in Figure 2. There are 24 such hourly printouts for each sampling day per site. The printout shows a compilation and statistical breakdown of the thousands of samples of noise level readings taken during the hour.

From the hourly printouts certain statistics of particular interest can be plotted to show the hour-to-hour variations of the noise levels during a sampling day at a particular site. Four examples of such daily plots can be seen in Figures 3, 4, 5, and 6 where L_{max}, L_{eq}, and L_{50} (see Glossary) for each hour for the Sherwood Village site.

The first two plots are during the "before" period (November 21-25) one day in which Runways 17L and 17R were used during southerly wind conditions and one day in which Runways 35L and 35R were used during northern wind conditions. The overall general effect of slightly larger L_{max} and L_{eq} levels for Runway 17

TYPICAL COMPUTER PRINTOUT

1121.1500	Date-Time	H
10.	Samples/sec.	C
120.	max. level	B
35800.	no. samples	A
0.	windy data	A
0.	overranges	A
63.0918	Hourly L_{eq}	L
64.0707		L
00.0000		L
64.0707	Cum. L_{dn}	L
46.0000	L_{99}	L
48.0000	L_{90}	L
52.0000	L_{50}	L
64.0000	L_{10}	L
76.0000	L_{01}	L
82.0000	$L_{.1}$	L
85.0000	$L_{.01}$	L
88.0000	L_{max}	L
11.0715	standard deviation	D

This data for period 1500 - 1600 Hrs.

21 Nov. 74

at SHERWOOD VILLAGE SITE

Figure 2. -- Typical Computer Printout

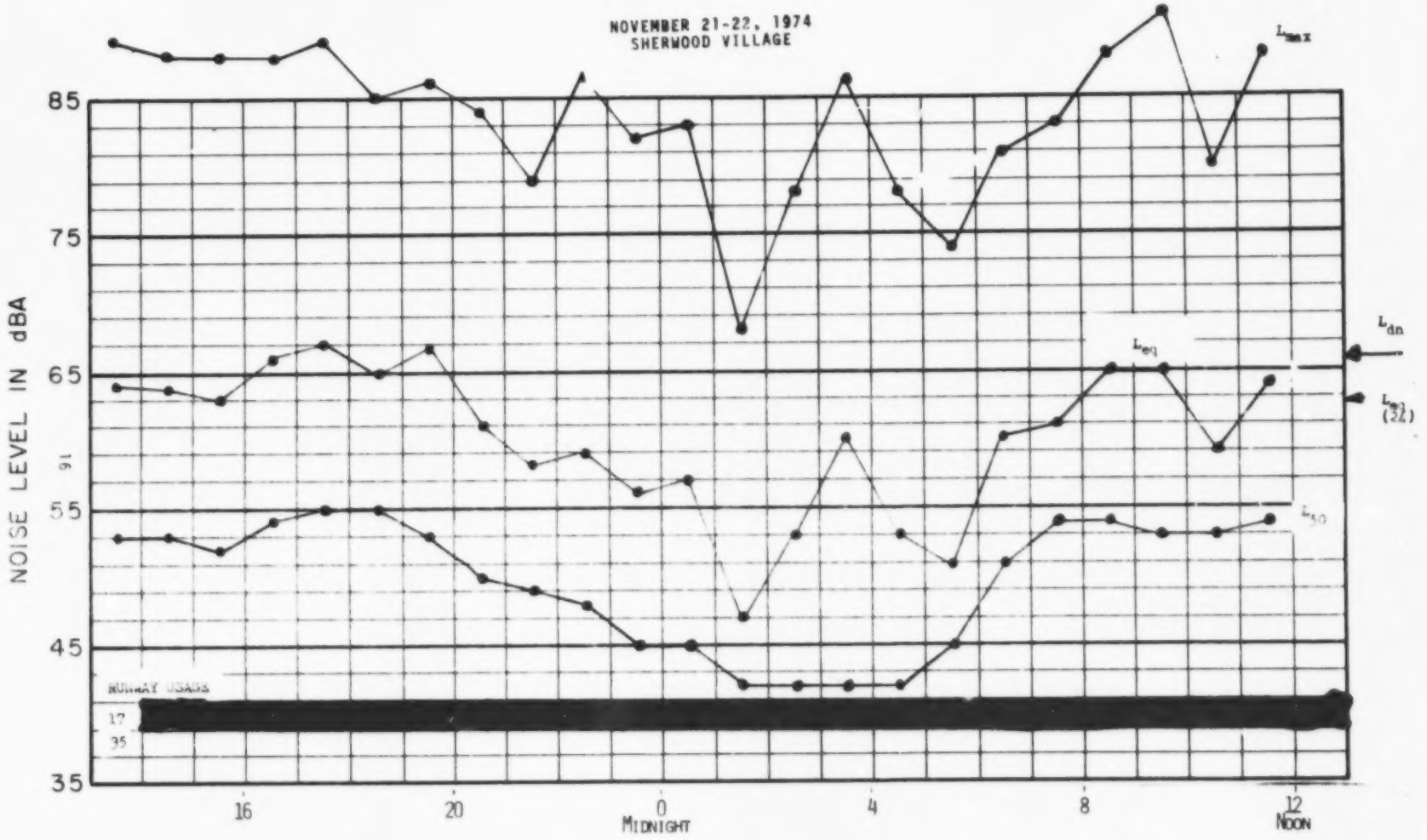


Figure 3. -- Hourly Plot - Nov. 21-22, 1974
Sherwood Village

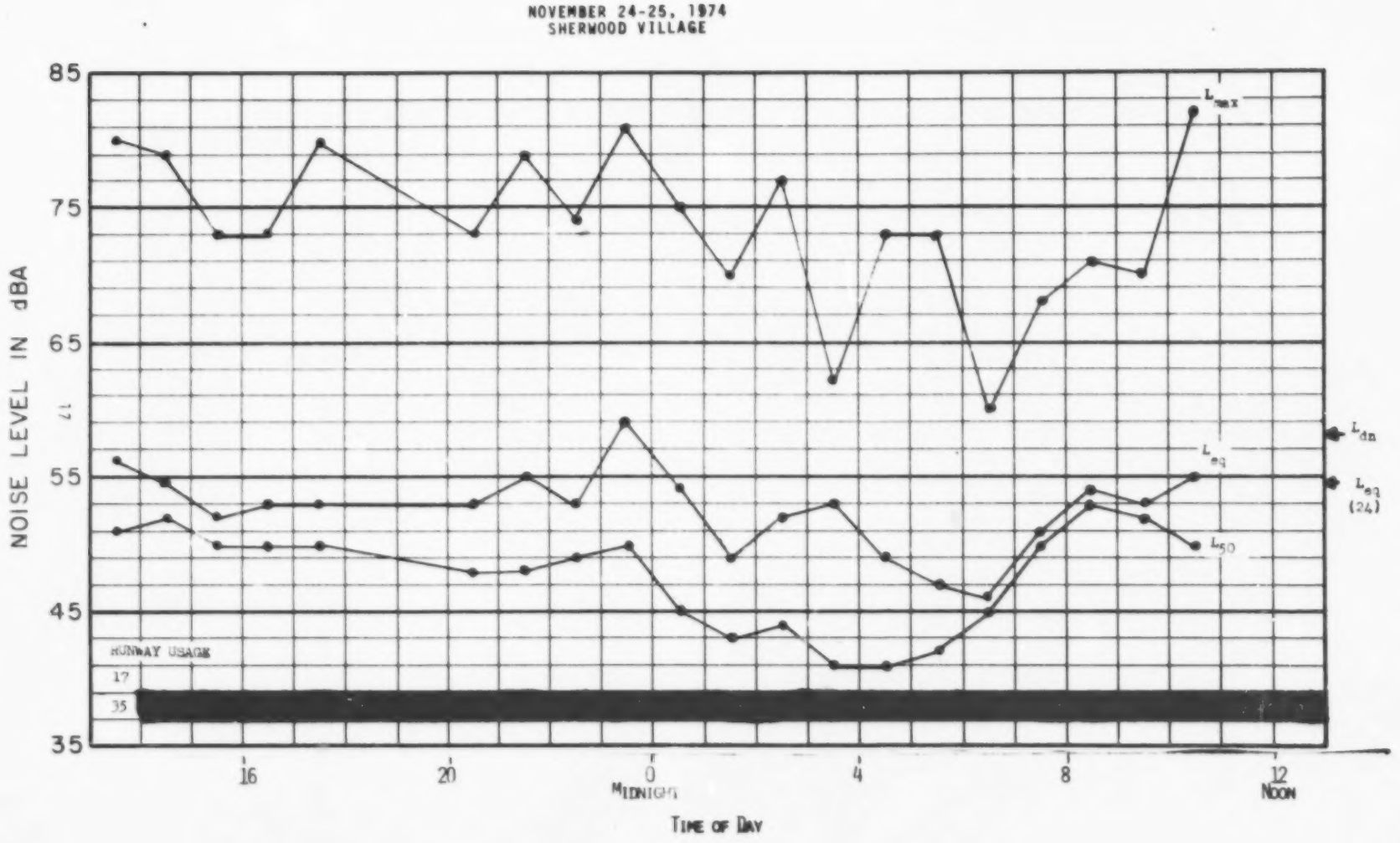


Figure 4. -- Hourly Plot - Nov. 24-25, 1974
Sherwood Village

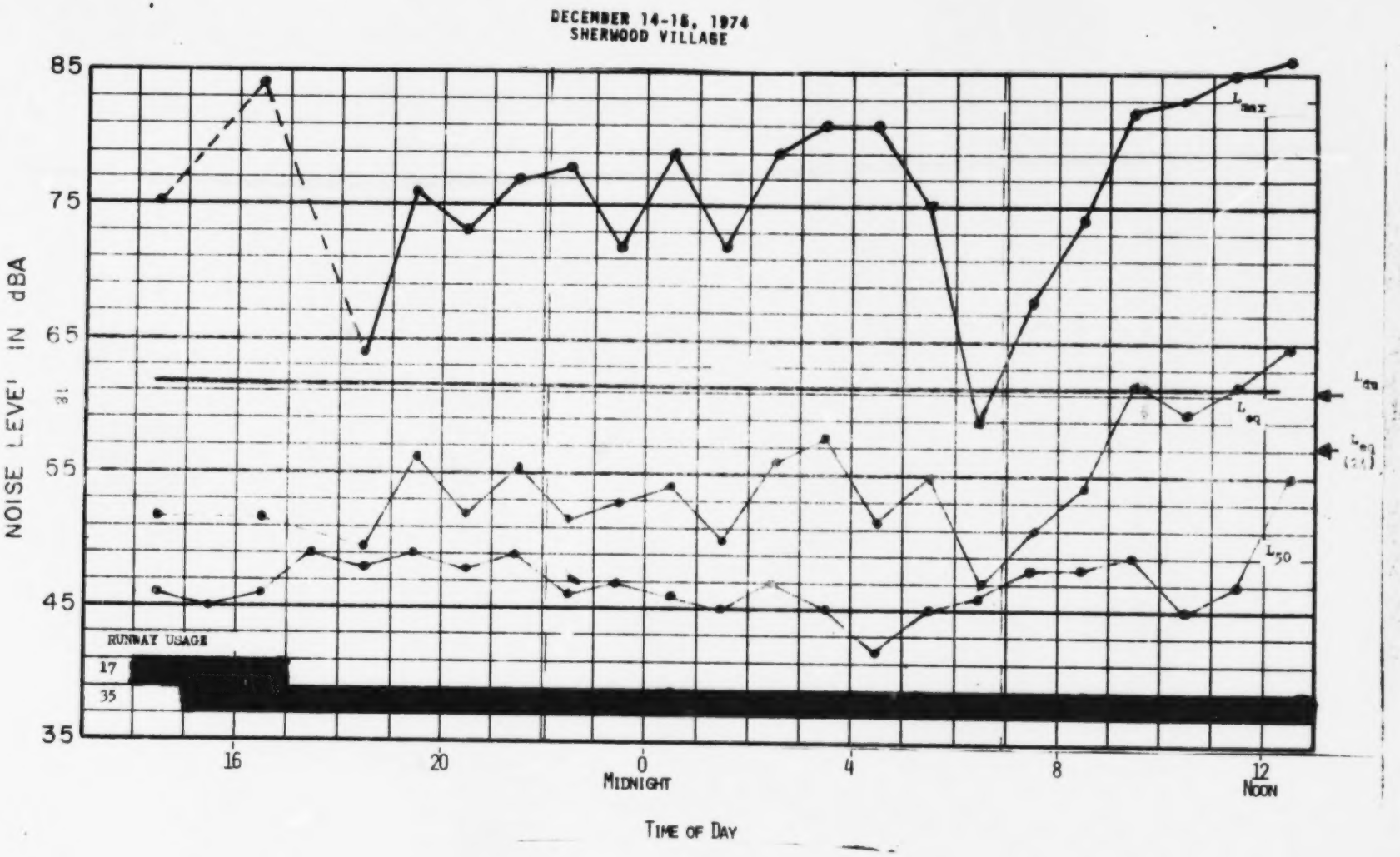


Figure 5. -- Hourly Plot - Dec. 14-15, 1974
Sherwood Village

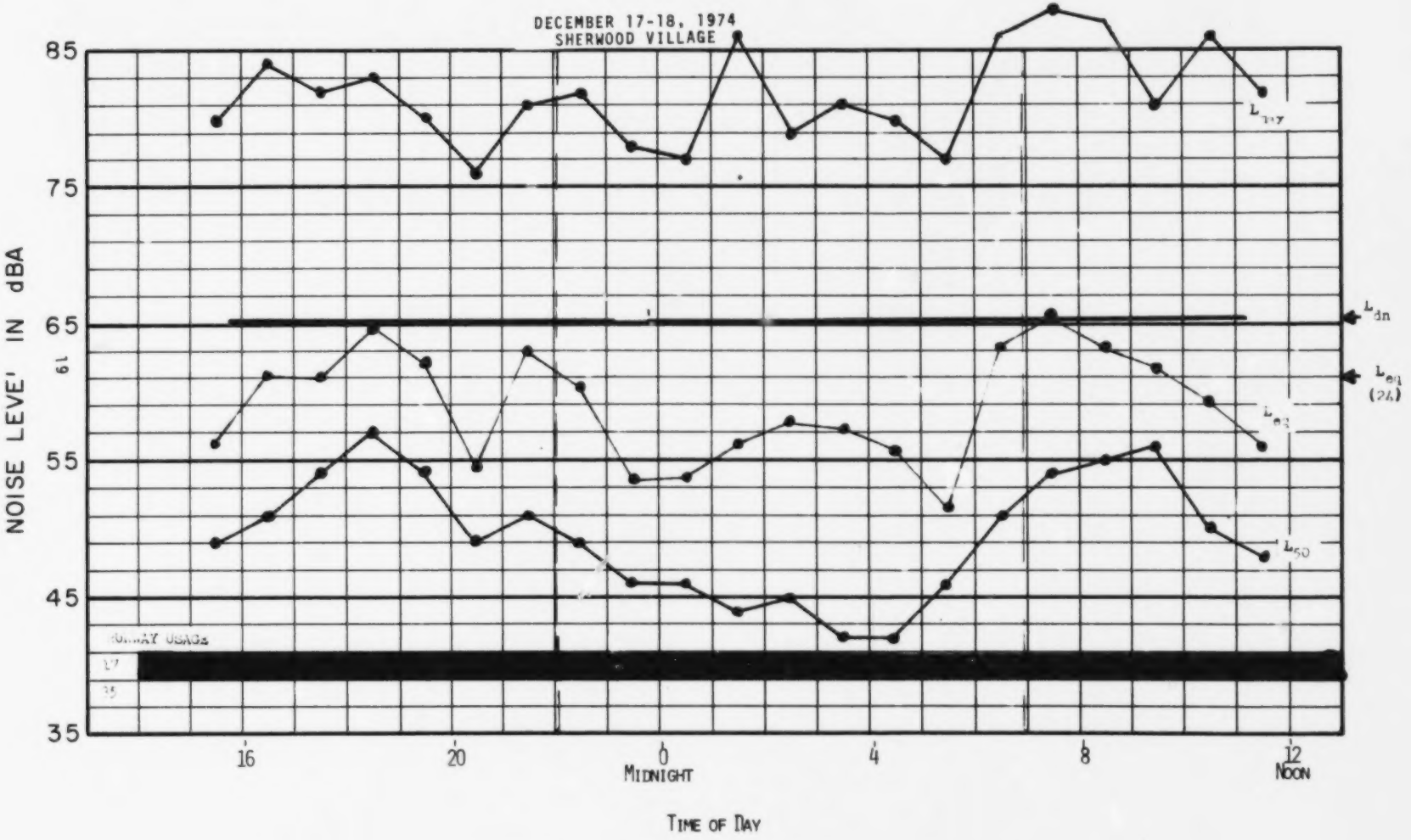


Figure 6. -- Hourly Plot - Dec. 17-18, 1974
Sherwood Village

usage can be seen. Also the usual low average (L_{50}) levels during normal sleeping hours can be seen on both Figures. The daily descriptors L_{eq} (24) and L_{dn} are shown at the extreme right side.

The next two plots, Figures 5 and 6, are for the same site during the "after" period (December 12-18) and represent two different days during which different runways were used at D/FW Airport. Again, slightly larger values for L_{max} and L_{eq} are generally noted for Runway 17 usage. However, it should also be noted that in general the L_{max} and L_{eq} levels are slightly lower for the "after" period as compared to the "before" period.

Similar plots were made for the Trinity and Cox Drive sites (during the "after" period) but much less Runway change effect was noted. These qualitative observations about the trends of the data will be discussed in quantitative terms later on.

In Figure 7 can be seen a few minutes of the playback of a continuous tape recording through a graphic level recorder. The two major sources indicated were identified visually. Tapes were used to help establish the relative magnitudes of aircraft and neighborhood sources during peak airport activity periods.

In Figure 8 a small portion of a graphic level recording of the playback of a microsample tape recording can be seen. This typically shows the listener's identification markings of source type and the peaks caused by aircraft sources. The "average"

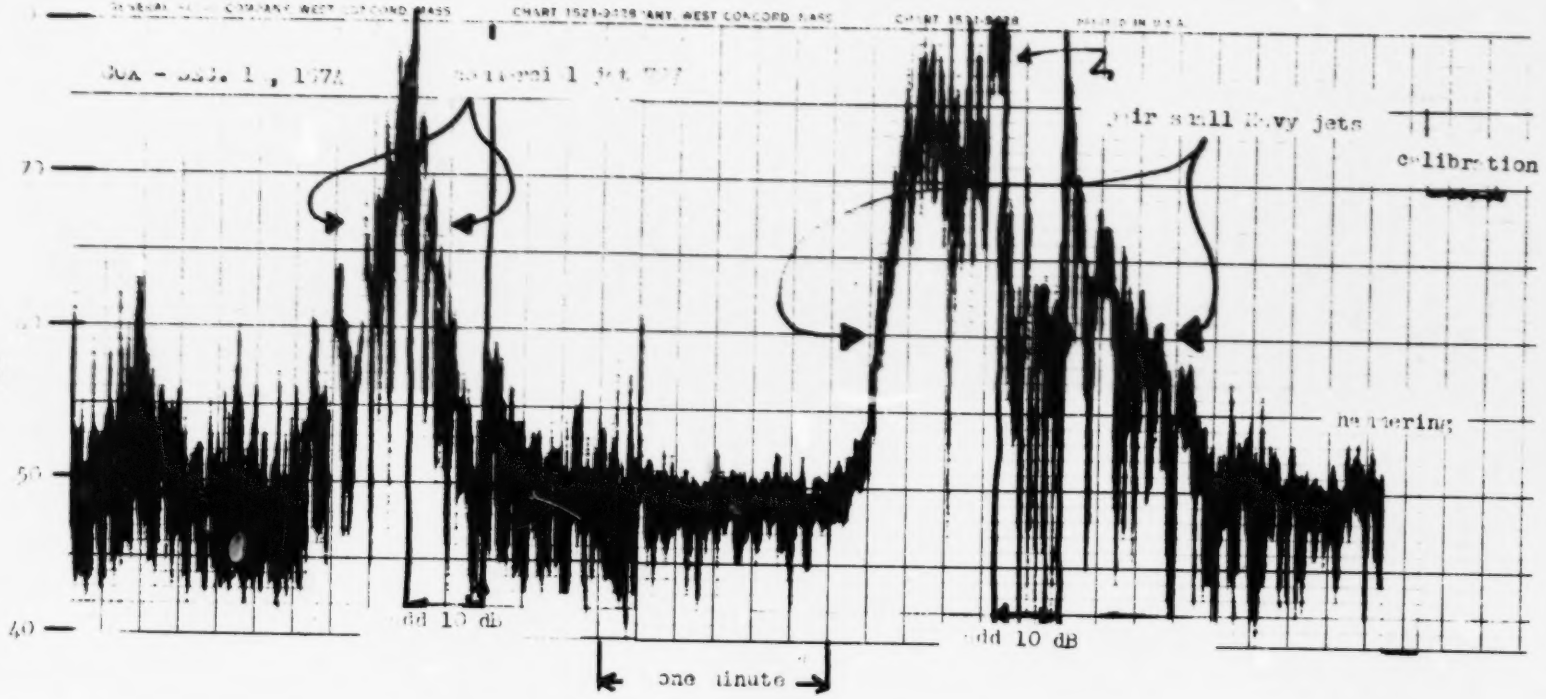


Figure 7. -- Typical Graphic Level Recording of Playback of Continuous Tape Recording

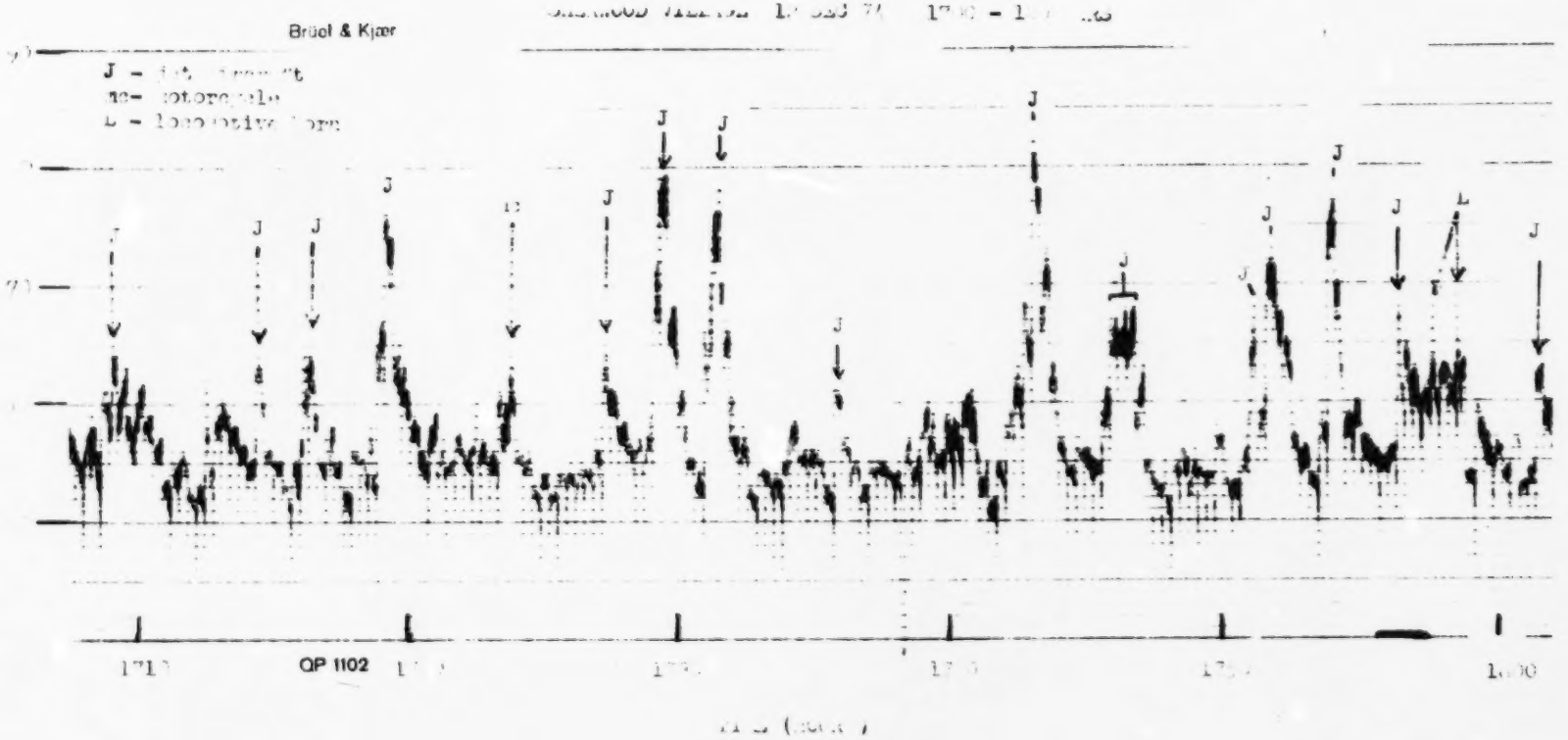


Figure 8. -- Graphic Level Recording of Microsample Tape

level can be seen to be about 50-55 dBA. The only recorded sources of noise greater than 70 dBA, other than aircraft, were motorcycles and locomotive horns, both of which were recorded only 5-10 times daily. Aircraft were the only sources recorded above 80 dBA.

In Table 1 can be seen part of a table of data of aircraft type, time, L_{max}, altitude, and runway usage compiled during a period of visual observation by FAA observers in radio contact with D/FW Airport from the Sherwood Village Site on December 12, 1974. The table indicates the wide variation in aircraft noise levels. The variation is due primarily to differences in flight path, altitude, aircraft type, aircraft load, pilot operating procedures, and atmospheric conditions. Averages of noise levels by aircraft type for the 9-hour observation period yielded average maximum levels which ranged from 74-69 dBA with the approximate order of aircraft type in decreasing loudness being B-727-100, B-707, B-727-200, DC-8, and DC-10.

The numbers and levels of commercial jet aircraft recorded by hour and levels during 1300-0100 HRS December 12, 1974 by the FAA can be seen in Table 2. In parentheses alongside the observed numbers of jet aircraft exceeding 70 or 80 dBA maximum noise levels are the numbers of jet aircraft identified and measured by means of the unmanned microsampling tape recording and playback method. On the whole, the agreement between the two

Table 1.

VISUAL AIRCRAFT IDENTIFICATION DURING
1700-1800 HR 12 DEC 74
AT SHERWOOD VILLAGE

HOUR	AIRCRAFT TYPE	RUNWAY	L_{max}*	ALTITUDE**
1703	B 727-100	17L	69	--
1704	DC-8	17L	70	3600'
1705	DC-8	17L	62	4000'
1708	B 727-100	17R	< 60	--
1709	B737	17L	--	--
1717	B727-200	17L	59	--
1719	B727-200	17R	77	5600'
1730	B 727-100	17L	70	4600'
1731	B 727-200	17R	81	5000'
1735	B 727-100	17L	77	4700'
1741	B727-100	17R	62	4200'
1743	B727-200	17R	60	4700'
1745	B727-200	17R	80	5000'
1748	B727-100	17L	71	4900'
1754	B727-200	17L	62	4600'
1755	DC-8	17L	73	3300'
1757	B727-200	17L	74	3900'
1759	B727-100	17L	69	3500'

* L_{max} is noise level in dBA with "SLOW" meter setting.

** Altitude (Mean Sea Level) of aircraft when Lmax was taken.

Table 2.

DECEMBER 12, 1974 SHERWOOD VILLAGE
NOISE LEVEL EXCEEDENCES BY COMMERCIAL
JET AIRCRAFT OBSERVED DEPARTING FROM D/FW AIRPORT

	HOUR	# AIRCRAFT L_{max} > 70 dB*		# AIRCRAFT L_{max} > 80 dB		TOTAL # AIRCRAFT	
	1300		18		6		21
	1400		4		1		19
	1500		4		1		8
	1600		8		0		12
**	1700	(8)	9	(1)	2	(17)	18
	1800	(9)	9	(1)	2	(21)	25
	1900	(7)	8	(1)	0	(12)	16
	2000	(1)	3	(0)	0	(7)	9
	2100	(8)	6	(2)	1	(10)	12
	2200	(6)	6	(2)	3	(9)	10
	2300	(1)	0	(0)	0	(6)	1
	2400	(3)	2	(0)	1	(5)	4
	0100	(0)	1	(0)	0	(3)	3
	Totals (1700-0100)	(43)	44	(7)	9	(90)	98

* Includes also number of aircraft for $L_{max} > 80$.

** Microsample tape recording began at 1700. Numbers in parentheses indicate jet aircraft identified only by sound from listening to microsample tape playback. Playback levels were measured on a graphic level recording. With the exception of two motorcycles and two locomotive horns, all noise levels above 70 dBA during period 1700-0100 were caused by aircraft of some type either propeller or jet.

sets of numbers appears to be quite good.

In Table 3 is shown a compilation of the numbers of jet aircraft whose L_{max} exceeded 70 or 80 dBA and the total number identified regardless of level as determined from playback of microsample tapes. No manned system of observation and recording of commercial jet aircraft leaving D/FW was employed during these periods; however, from the 9-hour comparison of the two systems on December 12, 1974 it is assumed that most of these are from D/FW Airport. Note the correspondence between the L_{dn} for the day and the number of aircraft whose L_{max} exceeded 70 dBA. Notice also the low correlation between L_{dn} and the number of aircraft whose L_{max} exceeded 80 dBA. This would be expected as the peak level of these jet aircraft is very near 80 dBA and the very nature of a microsampling method makes the probability of capturing the peak of a transient very small; whereas the probability of capturing some part of the event, i.e., $L_p > 70$ dBA, is very great.

In Tables 4, 5, and 6 are shown the compilations of the computer-gathered noise level statistics for each sampling day for each site. Also shown on the same table is D/FW runway usage and the total number of D/FW operations for the day. As the Tables indicate, there is a slight dependence of 2-3 dBA on runway usage, and no apparent dependence on the small variations of the number of airport operations. At the Sherwood Village site, comparisons

Table 3.

JET AIRCRAFT SOURCE IDENTIFICATION FROM
MICROSAMPLE TAPE PLAYBACK
SHERWOOD VILLAGE DECEMBER 12-18, 1974

DAY *	L_{dn}	# AIRCRAFT L_{max} > 70 dBA**	# AIRCRAFT L_{max} > 80 dBA	TOTAL # JET AIRCRAFT
12/12	64.7	53	8	123
12/13	62.8	46	8	106
12/14	61.3	35	1	96
12/15	62.0	45	7	116
12/16	61.2	32	1	96
12/17	65.3	89	10	142
12/18	61.1	31	1	114

* One day of microsampling is 20 hours of the 24 hours due to tape length, sample rate, and tape speed.

** Number also includes number of jet aircraft for L_{max} > 80 dBA.

Table 4.

TABLE OF DAILY VALUES OF L_{eq}, L_{dn}, AND L_{max}

FOR SHERWOOD VILLAGE SHOWING TOTAL D/FW

AIRPORT OPERATIONS AND RUNWAY USAGE

DAY	RUNWAY USAGE*	NO. OPERATIONS	L_{dn}	L_{eq}	L_{max}
11/21	17L&R	1026	65.4	62.7	91
11/22	17L&R	1041	65.6	62.2	92
11/23	17L&R & 35L&R	876	62.9	59.9	96
11/24	35L&R	921	58.2	54.5	81
		Averages	63.0	59.8	90
12/12	17L&R	962	64.7	59.6	89
12/13	35L&R & 17L&R	856	62.8	57.3	85
12/14	35L&R	835	61.3	57.4	86
12/15	35L&R	855	62.0	58.8	87
12/16	35L&R & 17L&R	886	61.2	56.0	80
12/17	17L&R	960	65.3	60.8	88
12/18	31R, 35L&R, 17L&R	927	61.1	55.3	86
		Averages	62.6	57.8	86

* Indicates runway number. Runway 17 used for takeoffs south, 35 used for takeoffs north. 31R is diagonal runway. Underlining indicates runway used most often during day during peak periods.

Table 5.

TABLE OF DAILY VALUES OF L_{eq}, L_{dn}, AND L_{max}

FOR TRINITY SITE SHOWING TOTAL D/FW

OPERATIONS AND RUNWAY USAGE

DAY	RUNWAY USAGE*	NO. OPERATIONS	L_{dn}	L_{eq}	L_{max}
12/12	17L&R	962	64.8	59.9	90
12/13	35L&R & 17L&R	856	60.8	55.4	83
12/14	35L&R	835	58.9	53.8	84
12/15	35L&R	855	59.8	57.8	91
12/16	35L&R & 17L&R	886	62.8	57.5	85
12/17	17L&R	960	63.3	58.8	86
12/18	31R, 35L&R, 17L&R	977	62.4	57.3	88
		Averages	61.8	57.2	86.7

* Indicates runway number. 17L&R used for takeoffs to south; 35L&R used for takeoffs to north; 31R used for northwest operations. Underlining of runway number indicates runway most often used during day during peak periods.

Table 6.

TABLE OF DAILY VALUES OF L_{eq}, L_{dn}, AND L_{max}

FOR COX SITE SHOWING TOTAL D/FW

OPERATIONS AND RUNWAY USAGE

DAY	RUNWAY USAGE *	NO. OPERATIONS	L_{dn}	L_{eq}	L_{max}
12/12	17L&R	962	57.6	53.3	89
12/13	35L&R & 17L&R	856	59.1	54.8	96
12/14	35L&R	835	56.7	54.0	95
12/15	35L&R	855	57.8	55.9	86
12/16	35L&R & 17L&R	886	57.2	53.2	80
12/17	17L&R	960	60.4	55.4	84
12/18	31L, 35L&R, 17L&R	977	59.2	55.6	86
		Averages	58.3	54.6	88.0

* Indicates runway number. 17L&R used for landings, takeoffs south; 35L&R used for landings and takeoffs to the north; 31R is for northwesterly operations. Underlining indicates runway used most often during day during peak periods.

of L_{dn}, L_{eq}, and L_{max} for "before" and "after" airport flight procedure changes indicate only 1-2 dBA reductions in L_{dn} and L_{eq} but about a 3-4 dBA reduction in L_{max}.

Since the L_{eq}, L_{dn}, and L_{max} indicators of the previous table are derived from the full day's measurements, other sources, in particular other non-D/FW aircraft, contribute to the daily statistics during non-peak periods of D/FW operations. Therefore it was felt that averages of the hourly L_{eq} and L_{max} during the peak periods of D/FW operation for each runway usage, 17 or 35, would be better indicators of the sensitivity of runway usage. In Table 7 are shown the average hourly L_{eq}, during peak hours, for the 7-day period for each runway usage and for each site. These averages show an interesting result: The average hourly L_{eq} during peak periods is significantly larger during use of runways 17L & 17R than for 35L and 35R for Sherwood Village and only slightly larger for the Trinity and Cox sites. Likewise, in Table 8 it can be seen that the differences in the average hourly L_{max} during peak periods is significantly larger for runways 17L and 17R than for 35L and 35R for the Sherwood Village site; slightly larger for the Trinity site; no difference for the Cox site.

Table 7.

PEAK HOURS* AVERAGES OF HOURLY L_{eq} FOR EACH

SITE ACCORDING TO RUNWAY USAGE

NOVEMBER 21 - 25, 1974

SHERWOOD VILLAGE

RUNWAY	AVERAGE L_{eq} **
17L&R	63 (13)
35L&R	52 (9)

DECEMBER 12 - 18, 1974

AVERAGE L_{eq} ALL SITES

RUNWAY	SH. VLG. **	TRINITY ST.**	COX DR.**
17L&R	61 (10)	59 (19)	56 (19)
35L&R	56 (17)	57 (27)	54 (27)

*Peak Hours 0630 - 0830
1215 - 1400
1700 - 1900

** Quantities in parentheses next to L_{eq} values are the number of hourly values of L_{eq} used to compute the averages.

Table 8.

PEAK HOUR* AVERAGES OF HOURLY L_{max} FOR

EACH SITE ACCORDING TO RUNWAY USAGE

NOVEMBER 21 - 25

SHERWOOD VILLAGE

RUNWAY	AVERAGE L_{max} **	
17L&R	87	(14)
35L&R	74	(9)

DECEMBER 12 - 18

AVERAGE L_{max} ALL SITES

RUNWAY	SH. VLG. **	TRINITY **	COX **
17L&R	84 (10)	78 (23)	75 (22)
35L&R	74 (17)	76 (23)	75 (22)

* Peak hours of D/FW operations are:
0630 - 0830
1215 - 1400
1700 - 1900

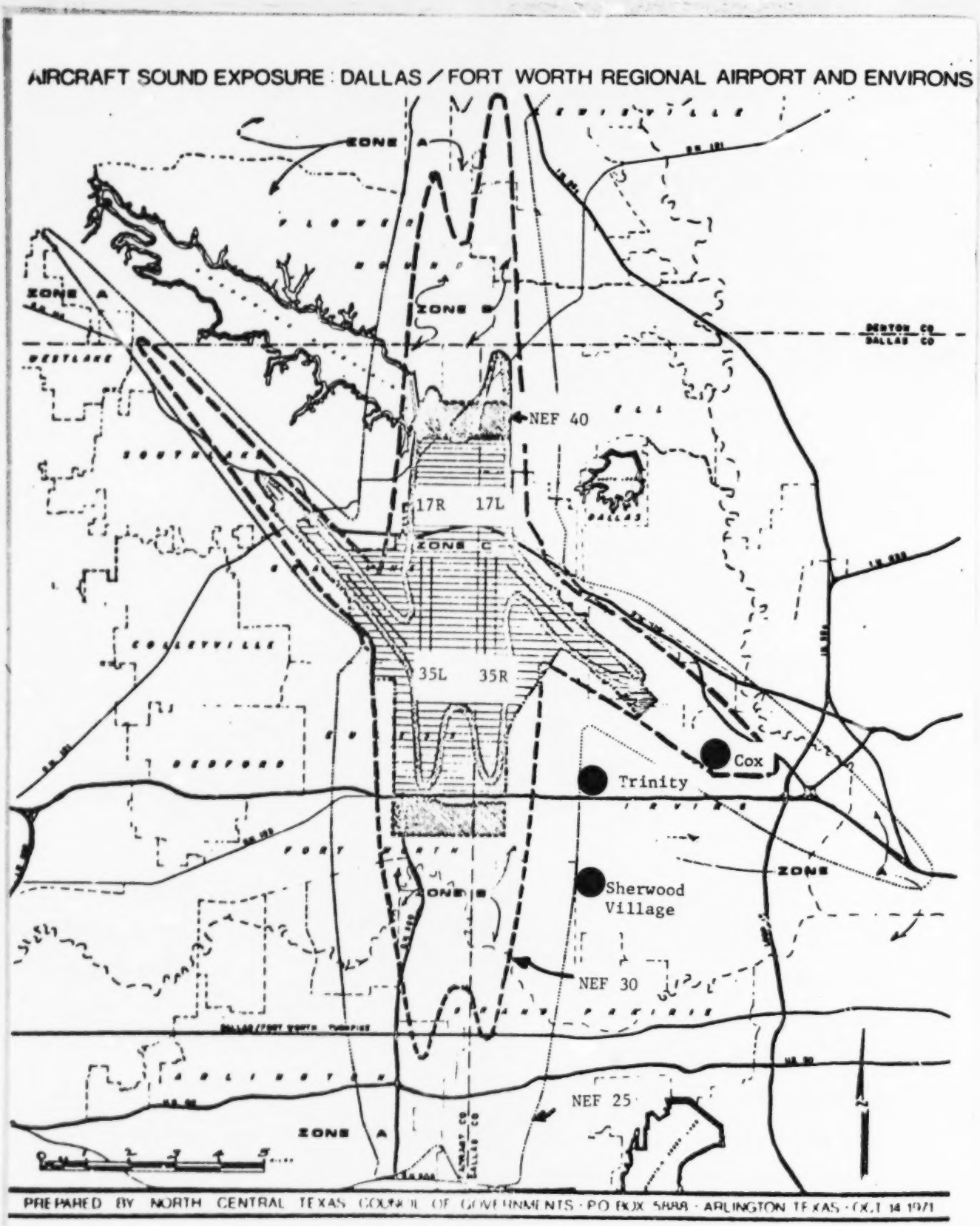
** Quantities in parentheses next to L_{max} values are the number of hourly values of L_{max} used to compute the averages

VIII. COMPARISON OF RESULTS WITH CRITERIA

Prior to the publication of the so-called "Levels" document[1] in March 1974, the EPA accepted the use of Noise Exposure forecast (NEF) contours, and other widely accepted criteria developed by technical experts in the noise control field. These special criteria were used in the evaluation of Environmental Impact Statements (EIS) in ascertaining the environmental impact of noise by projects which involved Federal agencies. This was the case when in 1972 the EPA reviewed and approved the Environmental Impact Statement for the D/FW Regional Airport.

The Environmental Impact Statement for D/FW Airport contained a map published by the North Central Texas Council of Governments in 1971 on which were drawn the NEF 40, 30, and 25 contours. This study was performed by the noise consulting firm of Bolt, Beranek, and Newman. A copy of that map is seen in Figure 9 on which the approximate locations of the three monitoring sites are superposed. The map indicates Cox Drive site to be inside the NEF-25 contour and the other two sites on the edge of the NEF-30 contour.* This map was widely disseminated in 1972 and used as a planning guide by many communities surrounding D/FW Airport, including Irving.

* As stated in an FAA planning guide, "NEF contours have an estimated error of tolerance of approximately +5 NEF's. Accordingly it is suggested that each contour be considered as having a possible range of 10 NEF."[3]



Based upon technical data furnished by the Federal Aviation Administration.

Figure 9. -- Aircraft Sound Exposure Map

Reproduced from best available copy.

An interpretation of the NEF contours and a land use planning guide went with the map and can be seen in Figure 10 with the NEF numbers added. (Originally the zones within the contours were named Zones C, B, and A instead of 40 NEF, 30 NEF, and 25 NEF.)

In order to compare the noise levels measured at the three sites with the forecast noise exposures indicated by NEF contours of the map it is necessary to use the L_{dn} descriptor. As stated in the "Levels" document[1] (p A-32):

> "There is no fixed relationship between L_{dn} or CNEL and CNR or NEF because of the differences between A-level and PNL frequency weightings and the allowance for duration, as well as the minor differences in approach to day-night considerations. Nevertheless one may translate from one measure to another by the following approximate relationship
>
> $$L_{dn} = CNEL = NEF + 35 = CNR - 35$$
>
> For most circumstances involving aircraft flyover noise, these relationships are valid within about a ±3 dB tolerance."

This tolerance, plus the ±5 NEF (±5 dB) tolerance for the contours themselves, makes an approximate overall error of tolerance of ±8 dBA when comparing L_{dn}'s to NEF values at contours.

In Table 9 are shown the L_{dn} values and approximate NEF values for each site and each day. As the data show, the NEF contour values (as derived from the L_{dn}'s) are well within the values forecast by the FAA in Figure 9 considering the above tolerances. For example, at Sherwood Village for the largest value of L_{dn} (65.6) conversion to NEF yields 30.6. This conversion has an error tolerance of approximately ±3 dBA (±3 NEF) and hence the range of possible values would be $27.6 < NEF < 33.6$. Comparison with the NEF 25 contour with its ±5 NEF error means the NEF 25 could be NEF 20 to NEF 30. The value of NEF 27.6 from measurements and conversion is less than NEF 30 allowed in the prediction, thus one cannot say that the measured NEF's are greater than the predicted NEF's.

AIRCRAFT SOUND EXPOSURE -

DALLAS/FORT WORTH REGIONAL AIRPORT

SOUND EXPOSURE FORECAST

This map indicates forecasted zones of perceived sound resulting from aircraft operations at the Dallas/Fort Worth Regional Airport from opening to that point in time where the activity now forecast for 1985 is reached. The degree of exposure to aircraft sound will diminish with distance from the airport runways and flight tracks.

The bands on the map represent areas where sound exposure is anticipated to be equal, in much the same way as contour lines are used on topographic maps to mark off points of equal elevation. Unlike topographic contours, however, the bands do not represent measured intensities, but are broad approximations of boundaries between the zones explained below.

INTERPRETATION OF MAP

In the interpretation of the map a number of points should be kept in mind. The map reflects current forecasts of aircraft operations through 1985. Zones shown are based upon the experiences of other regions. Changes in aircraft design, flight characteristics, or level of operations will alter the affected areas.

It has not been possible to take into consideration many of the factors (such as elevation, buffers, or tree cover) that influence perceived sound. Also, the map considers only aircraft related sound. The impact of other major sound producers, such as freeways and railroads, have not been included in the evaluation.

Furthermore, it should be noted that the sound areas identified on this map represent only one consideration among many that must be judged by local officials in drawing up planning and zoning regulations in the vicinity of the Airport. Specific inquiries concerning the permitted uses of land should be directed to appropriate local officials.

AIRPORT ENVIRONS LAND USE GUIDELINES

Zone A - Zone of minimal effect. Few activities will be affected by aircraft sounds except for especially sound-sensitive activities (such as auditoriums, churches, schools, hospitals, and theatres)

Figure 10. -- Sound Exposure at the Dallas/Fort Worth Regional Airport

in areas closest to the airport shown by the narrow dashed band. Sound control should be considered in the building design of such activities. Also in areas closest to the airport, open air activities may be disrupted. Detailed studies by qualified personnel are recommended for outdoor amphitheatres and like places of public assembly throughout the mid-cities area. Otherwise, so far as aircraft sound is concerned, generally all uses may be acceptable.

Zone B - Middle zone of effect. Activities where uninterrupted communication is essential should consider sound exposure in design. Generally, residential development is not considered a suitable use although multifamily developments where sound control features have been incorporated in building design might be considered. Open-air activities and outdoor living must consider aircraft sound. The construction of auditoriums, schools, churches, hospitals, and theatres and like activities should be avoided within this zone where possible.

The following types of uses may generally be considered without any special sound treatment: agricultural uses, mining, fishing; wholesale commercial and some retail; industrial/manufacturing, transportation, communication and utilities; cemeteries.

The following types of uses may be considered without any special sound treatment except when near Zone C: livestock farming and animal breeding; golf courses, riding stables, water-based recreational areas and cemeteries.

The following types of uses may be considered only if sound treatment is included in building design: multi-family apartments, dormitories, group quarters, orphanages, retirement homes, etc.; transient lodging, e.g., motels and hotels; office buildings, personal, business and professional services; retail commercial, movie theatres, restaurants; and noise-sensitive types of manufacturing and communications uses. In locations close to the Zone C boundary, consideration should be given to the limitations set forth in the following paragraph.

Zone C - Zone of greatest effect. Land should be reserved for activities that can tolerate a high level of sound exposure such as some agricultural, industrial and commercial uses. Such sound sensitive activities as schools, offices, hospitals, churches, and like activities should not be constructed in this area. No residential developments of any type are recommended. All regularly occupied structures should consider sound control in design.

--Prepared by the North Central Texas Council of Governments for use with the map entitled, "Aircraft Sound Exposure, Dallas/Fort Worth Regional Airport and Environs," dated October 14, 1971.

PURPOSE OF PREPARATION/DISCLAIMER

This presentation was prepared by NCTCOG with the assistance of the FAA solely for planning purposes with respect to future land use. NCTCOG and FAA have no expertise as to the effect of aircraft noise on the valuation of property. Accordingly, this presentation is not intended to, and does not reflect the views of NCTCOG or the FAA on the relationship, if any, between aircraft noise and the valuation of such property as may be comprehended by the presentation.

Table 9.

NOVEMBER 21 - 25

SHERWOOD VILLAGE

DATE	L_{dn}	APPROX. NEF *
11/21	65.4	30.4
11/22	65.6	30.6
11/23	62.9	27.9
11/24	58.2	23.2
Average	63.0	28.0

DECEMBER 12 - 18

L_{dn} (APPROX. NEF) --- ALL SITES

DATE	SH. VLG. *	TRINITY ST. *	COX DR. *
12/12	64.7 (29.7)	64.8 (29.8)	57.6 (22.6)
12/13	62.8 (27.8)	60.8 (25.8)	59.1 (24.1)
12/14	61.3 (26.3)	58.9 (23.9)	56.7 (21.7)
12/15	62.0 (27)	59.8 (24.8)	57.8 (22.8)
12/16	61.2 (26.2)	62.8 (27.8)	57.2 (22.2)
12/17	65.3 (30.3)	63.3 (28.3)	60.4 (25.4)
12/18	61.1 (26.1)	62.4 (27.4)	59.2 (24.2)
Averages	62.6 (27.6)	61.8 (26.8)	58.3 (23.3)

* Quantities in parentheses are approximate NEF values (± 3NEF error) obtained from formula NEF = L_{dn} - 35. NEF map contour errors of ± 5NEF must be considered in comparing NEF values derived from measurements with predicted map values. An overall error tolerance of ± 8NEF must be included in all comparisons.

EPA Criteria

Congress, in the Noise Control Act of 1972, charged the EPA with doing the necessary research and evaluation of criteria and environmental noise levels and to establish and publish two documents which identified the major causes and effects of noise[2] and which identified levels[1] which would protect the public health and welfare with an adequate margin of safety. It is emphasized that these criteria and levels were not to be standards or regulations but to represent identified levels for guidance in decision-making in the reduction of environmental noise through regulation of major noise sources.

In establishing the required identified levels to protect the public health and welfare, the EPA came to the conclusion that L_{dn} 60 was marginal and that a level L_{dn} 55 has an adequate margin of protection. The effects of a L_{dn} 55 are summarized in Table 13 and a summary of the Identified Levels can be seen in Table 14.

A comparison of the L_{dn} levels measured at the three sites during December 12-18, 1974 shows that in all cases the L_{dn} 55 level was exceeded and in fact the L_{dn} 60 was exceeded quite often especially at Sherwood Village. Furthermore the L_{dn} 65 was exceeded or approached at Sherwood Village and Trinity when runways 17L and 17R were heavily used. By EPA criteria, as stated in the "Levels Document"[1] these levels can be annoying to a significant percentage of the people that must endure it over long periods of time. (This document only establishes criteria as a decision-making tool and is not an accepted goal, standard, or regulation.)

Table 10.

SUMMARY OF HUMAN EFFECTS IN TERMS OF SPEECH COMMUNICATION, COMMUNITY REACTION, COMPLAINTS, ANNOYANCE AND ATTITUDE TOWARDS AREA ASSOCIATED WITH AN OUTDOOR DAY/NIGHT SOUND LEVEL OF 55 dB re 20 MICROPASCALS

Type of Effect	Magnitude of Effect
Speech - Indoors	100% sentence intelligibility (average) with a 5 dB margin of safety
- Outdoors	100% sentence intelligibility (average) at 0.35 meters
	99% sentence intelligibility (average) at 1.0 meters
	95% sentence intelligibility (average) at 3.5 meters
Average Community Reaction	None, 7 dB below level of significant "complaints and threats of legal action" and at least 16 dB below "vigorous action" (attitudes and other non-level related factors may affect this result)
Complaints	1% dependent on attitude and other non-level related factors
Annoyance	17% dependent on attitude and other non-acoustical factors
Attitudes Towards Area	Noise essentially least important of various factors

Table 11.

SUMMARY OF NOISE LEVELS IDENTIFIED AS REQUISITE TO PROTECT PUBLIC HEALTH AND WELFARE WITH AN ADEQUATE MARGIN OF SAFETY

Effect	Level	Area
Hearing Loss	$L_{eq(24)} \leq 70$ dB	All areas
Outdoor activity interference and annoyance	$L_{dn} \leq 55$ dB	Outdoors in residential areas and farms and other outdoor areas where people spend widely varying amounts of time and other places in which quiet is a basis for use.
	$L_{eq(24)} \leq 55$ dB	Outdoor areas where people spend limited amounts of time, such as school yards, playgrounds, etc.
Indoor activity interference and annoyance	$L_{dn} \leq 45$ dB	Indoor residential areas
	$L_{eq(24)} \leq 45$ dB	Other indoor areas with human activities such as schools, etc.

Explanation of Table 11:

1. Briefly, $L_{eq}(8)$ represents the sound energy averaged over an 8-hour period while $L_{eq}(24)$ energy averages over a 24-hour period. L_{dn} represents the L_{eq} with a 10 dB nighttime weighting.
2. The hearing loss level identified here represents annual averages of the daily level over a period of forty years. (These are energy averages, not to be confused with arithmetic averages.)

IX. NOISE CONTROL RESPONSIBILITIES OF EPA AND FAA

One of the objectives and goals of the EPA and the FAA is to reduce environmental noise of aircraft and airports under the directives of the Noise Control Act of 1972. Presently, the EPA Washington Office of Noise Abatement and Control is preparing to submit proposed aircraft/airport standards and regulations to the FAA by June 1975 for promulgation.* These proposed regulations will probably involve[4]:

(1) noise abatement flight procedures

(2) noise source emission regulations affecting the design of new aircraft and requiring the modification or phase-out of certain portions of the existing fleet and

(3) an airport noise regulation.[4]

During the past year the FAA has either issued rules, notices of proposed rule-making, or advance notices, in just about every area relating to control and abatement of aircraft noises. Projects are underway in nine of ten areas that EPA has recommended. the last one being the Airport Certification

* Notice No. 74-40, "Noise Abatement Minimum Altitudes for Turbojet Powered Airplanes in Terminal Areas," was published in the Federal Register, Vol. 40, No. 3, January 6, 1975.

Program. A comprehensive five-year FAA Environmental Improvement Program will be promulgated which will for the first time, from the FAA perspective, outline what needs to be done in the interrelationships of the various programs.

After these regulations are promulgated and put into effect, persons living in the surrounding environs of airports should experience a reduction in that portion of their overall noise exposure caused by commercial jet aircraft.

X. GLOSSARY

1. decibel, dB - unit of sound pressure level.
2. Sound pressure level, L_p - defined by the formula $10 \log \frac{p^2}{p_{ref}^2}$

   where p = root-mean-square sound pressure in N/m^2

   p_{ref} = reference root-mean-square sound pressure = 2×10^{-5} N/m^2
3. Noise level - sound pressure level
4. A-weighting - An electrical filter network employed in sound level meters to cause a meter to filter out very low and very high frequency components of sound so that the instrument response is closely correlated with human response to sound.
5. dBA, L_A - Sound pressure level measured after signal has been A-weighted.
6. L_y - the sound pressure level in dBA which is exceeded y percent of the time; eg. L_{50} is the level exceeded 50% of time.
7. L_{max} - maximum sound pressure level dBA achieved during a particular measuring period.
8. L_{50} - fifty percentile level. So called "steady state" or "average" level.
9. L_{eq} - Energy equivalent sound pressure level in dBA over a known sampling period. It

represents a constant sound pressure level which yields the same overall sound energy during the sampling period as all of the sources did which were actually present and causing a time varying sound level. It is computed from the following formula:

$$L_{eq} = 10 \log_{10} \left(\frac{1}{\sum_{i=1}^{N} S_i} \sum_{i=1}^{N} S_i 10^{L_i/10} \right)$$

where L_i is the sound pressure level observed for S_i number of samples. N represents the number of different discrete levels the sound pressure level scale is divided into.

$\sum_{i=1}^{N} S_i$ represents the total number of samples taken during the measuring period.

10. L_h - L_{eq} measured over a one hour sampling period.

11. L_d - L_{eq} measured and averaged over the assumed day period 0700-2200 hours.

12. L_n - L_{eq} measured and averaged over the assumed night period 2200-0700 hours.

13. L_{dn} - the day/night energy equivalent sound level. It is the same as L_{eq} except a 10 dBA penalty is added to nighttime levels between 2200-0700 hours. It is computed from the formula

$$L_{dn} = 10 \log \left[\frac{(15)\ 10^{Ld/10} + (9)\ 10^{\frac{L_n+10}{10}}}{24} \right]$$

14. NEF - acronym for Noise Exposure Forecast; a set of contours drawn around airports which represents the expected effect of noise on the land area enclosed by the contour. Contour values are computed based on flight path, aircraft class, number of day operations, number of night operations, runway usage, and other factors. Usual contours presented are NEF 40, NEF 30, and NEF 25. Contour lines are approximate in that they have expected errors in width of ±5 NEF; i.e., NEF 25 could range from NEF 30 to NEF 20. NEF contours are based on experimental sound data measured for the aircraft types which will be using the airport but are theoretical curves.

XI. REFERENCES

1. Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety, U.S. Environmental Protection Agency, March, 1974.

2. Public Health and Welfare Criteria for Noise, U.S. Environmental Protection Agency. July, 1973.

3. Airports and Their Environment - A Guide to Environmental Planning, prepared for Department of Transportation by CLM/Systems, Inc. September, 1972. DOT P 5600.1

4. Report on Aircraft-Airport Noise, U.S. Environmental Protection Agency, August 1973. U.S. Government Printing Office Stock Number 5270-01936.

APPENDIX A

LETTER DATED NOVEMBER 13, 1974
FROM CITY OF IRVING, TEXAS TO
ENVIRONMENTAL PROTECTION AGENCY

CITY OF IRVING

TEXAS 75060

OFFICE OF THE CITY MANAGER

November 13, 1974

Environmental Protection Agency
Region #6
1600 Patterson - Suite 1100
Dallas, Texas 75201

Attention: Mr. O. W. Bush
Regional Administrator

Re: Noise Monitoring Equipment

In a recent discussion with some members of CAN (Control Airport Noise) it was brought to our attention that the Regional EPA office would provide noise monitoring equipment upon request to determine the noise levels at specific locations.

This group was recently organized by citizens of Irving due to their concern regarding the noise created by the Dallas/Fort Worth Regional Airport. They have suggested that the City write a letter requesting the use of the monitoring equipment, hence we are suggesting that the following locations be considered for testing initially:

(1) Northgate Drive at Story Road
(2) Northgate Drive at MacArthur Boulevard
(3) Shady Grove Road at Belt Line Road
(4) Rock Island Road at Belt Line Road
(5) Other locations as determined by your sampling

Your cooperation in this matter is appreciated, and should you desire additional information, please contact this office.

Jack D. Huffman
City Manager

APPENDIX B

EPA MEMORANDUM DATED DECEMBER 10, 1974,
SUBJECT, PROPOSED NOISE MONITORING
PROJECT IN IRVING, TEXAS

Proposed Noise Monitoring Project in Irving, Texas December 10, 1974

Eloy R. Lozano
Director, Air & Hazardous Materials Division

Arthur W. Busch
Regional Administrator

On December 10, 1974, personnel from the Federal Aviation Administration and EPA met in the Regional Office to prepare a noise monitoring plan for the Irving area. This plan was to be developed as a result of a request from the City of Irving that such an assessment be made.

In attendance were:

Jim Santa Anna - FAA
John Beneventi - FAA
Norman Scroggins - FAA
George Putnicki - EPA
Tom Harrison - EPA
Hal Watson - EPA
Ray Lozano - EPA

Attached is a summary of a proposed monitoring plan which the group jointly developed. We suggest that you contact the Regional Office of the FAA and inform the Director of this proposal such that there will be concurrence on agreements reached during plan development.

cc: Jim Santa Anna - FAA
ASW-1B

6AAH:ERLOZANO:lj:X1121:12-XX74
-10-

APPENDIX C

PROPOSED NOISE MONITORING PROJECT IN IRVING, TEXAS

Proposed Noise Monitoring Project in Irving, Texas

Summary

Purpose - To determine noise exposure levels and, to extent possible, sources of these in the Irving area.

Sites - Vicinity of:

254-5446 — 1. Intersection of Shady Grove and Beltline — Sherwood Village Mobil Home Park Clubhouse

255-4584 — 2. Intersection of Northgate and MacArthur — Mrs. Eileen Wilson, 624 Cox Dr

255-8149 — 3. Area described by HW-183, Story, Grauwyler, and MacArthur. — Mrs. Zona Allen, 2625 Trinity (west of area & Stor N Gate)

Period of Sampling

1. December 12-20, 1974 for 3 stations
2. Indefinite period for 2 stations which will remain on site (depending on availability).

Type of Data to be Collected

1. FAA will identify aircraft, obtain available data on aircraft parameters thru TRACON and ARTS-3, provide some noise levels measured with hand held meters, and provide meteorological information during measurement period.

2. EPA will provide continuous sound level exposures (Leq and Ldn) and will identify types of noise with collected recorder data.

Personnel

1. FAA will provide technician at Shady Grove site for at least one continuous 24-hour period when Southerly wind is predominant. FAA will also provide personnel during peak aircraft traffic periods at all sites.

2. EPA will provide personnel to visit and maintain sites on an intermittent basis.

Equipment

Two complete hand held stations will be loaned to FAA by EPA. Otherwise, available equipment will be utilized by each agency for each group's monitoring needs.

Report

Complete report will be available on February 1, 1975. Report will include description of noise levels at each site with identifications, to extent possible, of source.

APPENDIX D

DFW NEWS RELEASE - NEW FLIGHT PATTERNS SET FOR DFW

For Immediate Release

DFW NEWS

NEW FLIGHT PATTERNS SET FOR DFW

Dallas/Fort Worth Airport, Texas, December 5, 1974.....As a result of reviews of flight patterns which have been under way for some time, ideas examined at a task force meeting held November 25, and subsequent staff analyses with operational and user personnel, DFW Airport Board announced that flight patterns will be modified so as to decrease the perceived sound level.

DFW Executive Director Ernest Dean said that under the new procedures, departures on runway 13L (the diagonal runway) would turn to a heading not greater than 115 degrees within one mile from the end of the runway. Previously the turn was to a 120 degree heading.

Departures on runways 17L and 17R (take-offs to the south) will maintain runway heading until reaching 4000 feet (Mean Sea Level). Previously a turn was to have been at 3000 feet (MSL).

Departures on runways 35L and 35R (take-offs to the north) will maintain runway heading for two miles from the end of the runway or until reaching 4000 feet (Mean Sea Level). The previous procedure called for a minimum of one mile or 3000 feet (MSL).

Dean said, "These procedures may decrease, somewhat, the operating efficiency of the airport, but they will enable us to be better neighbors to the communities around us."

The procedures will go into effect as soon as air traffic controllers and pilots can be briefed on the changes.